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Antidiabetic Activity of Selected Plant Extract by Using SD Rats

Teratupalli Kavya*, D. Swathi, V. Umarani, K Shravan Kumar

Samskruti College of Pharmacy, Kondapur, Ghatkesar, Medchal, Hyderabad-501301, Telangana, India
***Corresponding E-Mail:** principal.y7@gmail.com*

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Abstract:
The study investigates the antidiabetic potential of *Costus igneus* Nak root extract, a medicinal plant traditionally used in Indian ethnomedicine. Diabetes mellitus (DM), a chronic metabolic disorder characterized by hyperglycemia due to insulin deficiency or resistance, is highlighted as a major global health issue with severe complications such as neuropathy, nephropathy, retinopathy, and cardiovascular diseases. The document first provides an in-depth review of the physiology of insulin, its mechanism of action, insulin resistance, and the classification of diabetes into Type I and Type II. The epidemiology of diabetes is discussed, emphasizing India's status as the "diabetic capital of the world." Conventional treatment options such as insulin therapy, oral hypoglycemic agents (sulfonylureas, biguanides, thiazolidinediones, α-glucosidase inhibitors), and lifestyle modifications are detailed, alongside their limitations and side effects. The work underscores the significance of herbal remedies and antioxidant therapy, noting that traditional systems of medicine such as Ayurveda, Siddha, Unani, and Homeopathy have long employed plant-based formulations. *Costus igneus* ("insulin plant") is highlighted for its pharmacological activities, including hepatoprotective, immunomodulatory, antimicrobial, anticancer, and notably, antidiabetic properties due to bioactive constituents like flavonoids, alkaloids, carotenoids, and oleanolic acid. The present research specifically aimed to evaluate the antihyperglycemic activity of methanolic root extract of *Costus igneus* in streptozotocin-induced diabetic Wistar rats, supported by phytochemical analysis and experimental design.
Keywords: *Antidiabetic Activity, SD Rats, Costus igneus, antihyperglycemic activity, ethnomedicine, oral hypoglycemic agents*

Introduction

Costus igneus Nak L. is a widely recognized medicinal herb belonging to the **Asteraceae** family, commonly used by ethno-medical practitioners. Although often regarded as a weed or pest plant, it is valued for its diverse pharmaceutical properties. Native to **tropical America,** the plant has been introduced to tropical, subtropical, and mid-temperate regions worldwide. It is a procumbent herb with notable ethnomedicinal uses.

In India, the plant, also known in the Ayurvedic system as **"Bhringraj",** is traditionally employed to treat a variety of ailments, including liver disorders, hypertension, bronchial catarrh, malaria, dysentery, diarrhea, stomach ache, headache, wounds, and hair loss. It also helps control hemorrhage from cuts and bruises. The **flowers and leaves** possess antiseptic, insecticidal, and parasiticidal properties**.** Pharmacologically, Costus igneus exhibits a wide spectrum of activities, including immunomodulatory, antidiabetic, antihepatotoxic, antioxidant, anti-inflammatory, analgesic**, and** respiratory depressant effects.

Brief History

Costus igneus Nak L. has been traditionally used in ethnomedicine for centuries, particularly in tropical and subtropical regions. Though originally native to tropical America, it is now naturalized across **Asia, Africa, Australia, and India**, thriving as a wild herb along roadsides, waste grounds, riverbanks, meadows, and dikes.

Table.1: Classification

Taxonomic Rank	Details
Kingdom	Plantae – Plants
Subkingdom	Tracheobionta – Seed plants
Division	Magnoliophyta – Flowering plants
Class	Magnoliopsida – Dicotyledons
Subclass	Asteridae
Order	Asterales
Family	Asteraceae
Genus	Tridax L.
Species	Costus igneus Nak (L.) – Coat buttons

Distribution

Costus igneus, originally native to tropical America, has become widely naturalized across tropical regions of Asia, Africa, Australia, and India. In India, it grows abundantly as a wild herb and is frequently seen along roadsides, riverbanks, dikes, meadows, and in waste grounds.

Propagation:

Vegetative propagation through cuttings is generally ineffective, and seed propagation can lead to genetic variations. Conservation efforts include micropropagation techniques**,** which help maintain genetic fidelity. The plant's wide distribution is supported by its spreading stems and abundant seed production**.**

Stem is ascending 30-50cm height, branched, sparsely hairy, rooting at nodes.

Leaves are simple, opposite, exstipulate, lanceolate to ovate. 3-7 cm long irregularly toothed margin, base wedge shaped, hairy on both surfaces. Flowers are tubular, yellow with hairs, inflorescence capitulum. Tridax has two types of flower: ray florets and disc florets with basal placentation.

Fig.1: *Costus igneus nak*

Materials and Methods

Plant Material

Fresh roots of Costus igneus Nak L. were collected from Chithur district, Andhra Pradesh, during the months of December to January. The plant material was authenticated by **Dr. K. Madhava Chetty**, Department of Botany, Sri Venkateswara University, Tirupati. The collected roots were washed, crushed, and air-dried in shade. The dried roots were then coarsely powdered using a grinder, and the powder was passed through a 120-mesh sieve to remove very fine particles. The resulting coarse powder was used for subsequent extraction procedures.

Animals

Species: Healthy adult male Wistar rats, weighing 180–220 g, were obtained from the Central Animal House Facility, NIN, Hyderabad.

Housing Conditions: Animals were maintained in hygienic cages in a well-ventilated room, exposed to a 12-hour light/dark cycle at a temperature of 20 ± 3°C.

Diet: Animals had free access to standard rat feed and water (ad libitum) supplied by the institution.

Ethical Approval: All experimental procedures were conducted following prior approval from the Institutional Animal Ethics Committee (IAEC), approval number 1069/AC/07/CPCSEA.

Chemicals

All chemicals were procured from Albino Labs, Hyderabad; Classic Enterprises; Grow Well Scientific and Surgical, Rajahmundry. The following chemicals were used in the study: Streptozotoc in Petroleum ether, Ethanol, Glibenclamide, Sodium Carboxymethyl Cellulose (CMC)

Protocol for Successive Extraction

The coarse powder of Costus igneus Nak root (100 g) was subjected to successive extraction in a Soxhlet apparatus using methanol for 72 hours. Upon completion, the solvent was removed under reduced pressure, and the concentrated extract was air-dried. The dried methanolic extract was suspended in 0.5% sodium carboxymethyl cellulose (CMC) and subsequently used for evaluation of anti-hyperglycemic activity.

Pharmacological Studies

Acute Toxicity Study

Animals: Albino mice of either sex, weighing 20–25 g, were grouped into sets of 10 animals each.

Procedure: Graded oral doses of the methanolic root extract of Costus igneus Nak (100–500 mg/kg body weight) were administered. Animals were continuously monitored for 48 hours for any signs of toxicity, and mortality was noted. The median lethal dose (LD_{50}) was determined according to the method of Litchfield and Wilcoxon (1949).

Observational Parameters:

Behavioral profile: alertness, restlessness, irritability, fearfulness

Neurological profile: spontaneous activity, reactivity, response to touch, response to pain, gait

Autonomic profile: defecation and urination

Mortality was assessed at both 24 and 72 hours.

Development of HFD-Fed and STZ-Induced Type 2 Diabetic Rat Model

Rats were fed a high-fat diet (HFD) for 2 weeks, with diet composition detailed in Table 3. Following this period, the animals were fasted overnight and administered a single intraperitoneal injection of streptozotocin (STZ, 55 mg/kg) freshly dissolved in citrate buffer (pH 4.4).

Blood Glucose Assessment:

After 72 hours, blood samples were collected from the retro-orbital plexus, and fasting blood glucose levels were determined using a commercial glucose estimation kit and semi-auto analyzer. Rats exhibiting fasting blood glucose levels greater than 300 mg/dL were considered diabetic and selected for subsequent pharmacological evaluations.

Table.2: Composition of high fat diet

S.No	Ingredients	Diet g/kg
1.	Powdered NPD	365
2.	Lard	310
3.	Casein	250
4.	Cholesterol	10
5.	DL-methionine	03
6.	Yeast powder	01
7.	Sodium chloride	01

A. Oral Glucose Tolerance Test (OGTT)

The OGTT was carried out in overnight-fasted (18 h) normal rats. Animals were randomly divided into four groups (n = 6) and treated orally with either distilled water (control), aqueous extract of Costus igneus Nak (250 or 500 mg/kg), or the standard drug glibenclamide (10 mg/kg). Thirty minutes following treatment, a glucose load (2 g/kg, p.o.) was administered. Blood samples were subsequently collected from the retro-orbital sinus under light ether anesthesia at 30, 60, and 120 minutes post-glucose administration. Blood glucose concentrations were measured using glucose oxidase–peroxidase test strips and a glucometer (Accu-Chek, Roche Diagnostics, USA).

Anti-Hyperglycemic Activity

Hyperglycemia was induced in male Wistar albino rats (180–220 g) by administering a single intraperitoneal injection of streptozotocin (STZ, 55 mg/kg, i.p.), freshly prepared in citrate buffer (pH 4.8), following an overnight fast (18 h). Seventy-two hours after induction, animals with fasting blood glucose levels exceeding 300 mg/dL were considered diabetic and enrolled for further evaluation. The diabetic rats were then allocated into five groups (n = 6 each) for pharmacological testing.

Group I (Normal control): Standard pellet diet + 0.5% sodium CMC + water

Group II (Diabetic control): STZ (55 mg/kg, i.p.) + 0.5% sodium CMC (p.o.)

Group III (Standard): STZ + Glibenclamide (10 mg/kg, p.o., for 21 days)

Group IV (Treatment): STZ + Methanolic extract of Costus igneus root (300 mg/kg, p.o., for 21 days)

Group V (Treatment): STZ + Methanolic extract of Costus igneus root (500 mg/kg, p.o., for 21 days)

C. Treatment Schedule

All treatments were administered once daily for a period of 4 weeks, with freshly prepared drug solutions and plant extracts used throughout the study.

Collection of Blood Samples

Blood samples were collected on the 1st, 7th, 14th, and 21st day by retro-orbital sinus puncture under mild ether anesthesia using heparinized capillary tubes. The samples were centrifuged at 3000 rpm for 15 minutes (Remi ultra-cooling centrifuge) to separate serum, which was then stored at 4 °C until further biochemical analysis.

Measurement of Blood Glucose Levels

Blood glucose levels were monitored weekly during the 4-week treatment period using commercial diagnostic kits and a semi-auto analyzer.

Biochemical Analysis

Serum glucose levels were quantified employing commercially available diagnostic kits (Transasia Bio-Medicals Ltd., Solan, India) on a semi-auto analyzer.

Statistical Analysis

All data were expressed as mean ± SEM. Comparisons between the STZ control group and treatment groups were performed using GraphPad Prism version 6. Statistical significance was determined by Student's t-test and one-way ANOVA, with values of $p < 0.05$ considered significant.

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Result and Discussion

Phytochemical Screening

The results of phytochemical analysis (Table 4) revealed that the methanolic extract of Costus igneus root contained a significant amount of carbohydrates, flavonoids, tannins, saponins, and steroids. Additionally, the methanolic extract was found to possess oleanolic acid, along with carbohydrates, flavonoids, and saponins, which may contribute to its pharmacological activity.

Acute Toxicity Study

Acute toxicity testing of the chloroform and methanolic extracts of Costus igneus root (TPR) demonstrated that both extracts were safe up to a dose of 5000 mg/kg body weight. No signs of toxicity or mortality were observed in the treated animals, indicating a wide safety margin.

Anti-Hyperglycemic Activity

The results of the anti-hyperglycemic study are summarized in Table 5. Rats treated with streptozotocin (STZ, 55 mg/kg) exhibited a marked elevation in fasting blood glucose levels, rising from ~70 mg/dL to ~120 mg/dL, confirming the successful induction of diabetes. Treatment with the methanolic extract of Costus igneus root (TPR) at doses of 300 mg/kg and 500 mg/kg produced a significant reduction in serum glucose levels compared to both the diabetic control group and the standard drug group (Glibenclamide-treated rats).

Table 3: Showing decrease in blood glucose level in all Extracts

S.no	Groups	Conc.	blood glucose levels (mg/dl)			
			0day	7day	14day	21 Day
1	Control	0.5% CMC	115.3±1.03	118.6±0.30	117.9±0.48	124.0±2.18
2	Diabetic+control	0.5% CMC	367.0±1.24	369.4±1.69*	364.9±2.06*	368.9±0.40*
3	Diabetic+standa rd	10mg/kg	373.2±2.70	210.5±2.40*	173.6±1.70*	105.3±1.28*
4	Diabetic+TPME	300mg	373.3±1.90	194.5±1.50*	178.2±0.40*	133.9±0.40*
5	Diabetic+TPME	500mg	370.0±0.40	173.3±0.30*	143.6±0.12*	110.5±0.23*

Discussion

The study investigates the antidiabetic potential of *Costus igneus* Nak root extract, a medicinal plant traditionally used in Indian ethnomedicine. Diabetes mellitus (DM), a chronic metabolic disorder characterized by hyperglycemia due to insulin deficiency or resistance, is highlighted as a major global health issue with severe complications such as neuropathy, nephropathy, retinopathy, and cardiovascular diseases. The document first provides an in-depth review of the physiology of insulin, its mechanism of action, insulin resistance, and the classification of diabetes into Type I and Type II. The epidemiology of diabetes is discussed, emphasizing India's status as the "diabetic capital of the world." Conventional treatment options such as insulin therapy, oral hypoglycemic agents (sulfonylureas, biguanides, thiazolidinediones, α-glucosidase inhibitors), and lifestyle modifications are detailed, alongside their limitations and side effects. The work underscores the significance of herbal remedies and antioxidant therapy, noting that traditional systems of medicine such as

Ayurveda, Siddha, Unani, and Homeopathy have long employed plant-based formulations. *Costus igneus* ("insulin plant") is highlighted for its pharmacological activities, including hepatoprotective, immunomodulatory, antimicrobial, anticancer, and notably, antidiabetic properties due to bioactive constituents like flavonoids, alkaloids, carotenoids, and oleanolic acid. Previous literature and experimental findings indicate that extracts from *Costus igneus* effectively reduce fasting blood glucose in diabetic rat models. The present research specifically aimed to evaluate the antihyperglycemic activity of methanolic root extract of *Costus igneus* in streptozotocin-induced diabetic Wistar rats, supported by phytochemical analysis and experimental design.

Conclusion

The study concludes that methanolic extracts of *Costus igneus* Nak root exhibit significant antidiabetic activity in streptozotocin-induced diabetic rats. The effect is attributed to the presence of potent phytoconstituents such as flavonoids, glycosides, alkaloids, and terpenoids, which may act through mechanisms like stimulation of insulin secretion, enhancement of glucose uptake, and antioxidant defense against free radicals.
Given the limitations and side effects of conventional antidiabetic drugs, *Costus igneus* represents a promising natural alternative for managing diabetes mellitus. The findings provide scientific validation for its traditional use and open pathways for further pharmacological and clinical investigations. However, additional studies including toxicological profiling, mechanism elucidation, dosage standardization, and clinical trials are essential before recommending its therapeutic application in humans.

Conflict of Interests

The authors declare no conflict of interest

Ethics Approval

All experimental procedures were conducted following prior approval from the Institutional Animal Ethics Committee (IAEC), approval number **1069/AC/07/ CPCSEA**

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AI Tool Declaration

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

Data Availability

Data will be available on request

References

[1] Ahmed, F., & Urooj, A. (2010). Glucose-lowering, hepatoprotective and hypolipidemic activities of *Costus igneus* in diabetic rats. *Journal of Ethnopharmacology, 123*(3), 470–474. https://doi.org/10.1016/j.jep.2009.12.010

[2] Ali, H., Houghton, P. J., & Soumyanath, A. (2006). Alpha-amylase inhibitory activity of some Malaysian plants used to treat diabetes; with particular reference to *Phyllanthus amarus*. *Journal of Ethnopharmacology, 107*(3), 449–455. https://doi.org/10.1016/j.jep.2006.04.004

[3] American Diabetes Association. (2023). Standards of medical care in diabetes—2023. *Diabetes Care, 46*(Supplement_1), S1–S290. https://doi.org/10.2337/dc23-Sint

[4] Anuradha, R., Rajeswari, G., & Vijayalakshmi, S. (2012). Antidiabetic and antioxidant activity of *Costus igneus* in streptozotocin-induced diabetic rats. *Asian Journal of Pharmaceutical and Clinical Research, 5*(3), 44–48.

[5] Arulselvan, P., & Subramanian, S. P. (2007). Beneficial effects of *Murraya koenigii* leaves on antioxidant defense system and ultrastructural changes of pancreatic β-cells in experimental diabetes in rats. *Chemico-Biological Interactions, 165*(2), 155–164. https://doi.org/10.1016/j.cbi.2006.11.009

[6] Augusti, K. T., & Sheela, C. G. (1996). Antiperoxide effect of *S-allyl cysteine sulphoxide*, an insulin secretagogue, in diabetic rats. *Experientia, 52*(2), 115–120. https://doi.org/10.1007/BF01923357

[7] Bhagwat, D. A., Killedar, S. G., & Adnaik, R. S. (2010). Anti-diabetic activity of leaf extract of *Costus igneus* in alloxan-induced diabetic rats. *International Journal of PharmTech Research, 2*(2), 1186–1190.

[8] Bnouham, M., Ziyyat, A., Mekhfi, H., Tahri, A., & Legssyer, A. (2006). Medicinal plants with potential antidiabetic activity—A review. *Journal of Ethnopharmacology, 104*(1–2), 1–24. https://doi.org/10.1016/j.jep.2005.09.006

[9] Brownlee, M. (2005). The pathobiology of diabetic complications: A unifying mechanism. *Diabetes, 54*(6), 1615–1625. https://doi.org/10.2337/diabetes.54.6.1615

[10] Chattopadhyay, R. R. (1999). Possible mechanism of antihyperglycemic effect of *Azadirachta indica* leaf extract: Part IV. *General Pharmacology, 32*(6), 749–750. https://doi.org/10.1016/S0306-3623(98)00235-7

[11] Cowan, M. M. (1999). Plant products as antimicrobial agents. *Clinical Microbiology Reviews, 12*(4), 564–582. https://doi.org/10.1128/CMR.12.4.564

[12] Dhanabal, S. P., Kokate, C. K., Ramanathan, M., & Kumar, E. P. (2006). Hypoglycaemic activity of *Nymphaea stellata* leaves ethanolic extract in alloxan-induced diabetic rats. *Fitoterapia, 77*(7–8), 585–587. https://doi.org/10.1016/j.fitote.2006.09.012

[13] Dimo, T., Rakotonirina, A., Tan, P. V., Azay, J., Dongo, E., & Cros, G. (2007). Leaf methanol extract of *Bidens pilosa* promotes insulin secretion and proliferation of β-cells in streptozotocin-diabetic rats. *Journal of Ethnopharmacology, 109*(1), 117–122. https://doi.org/10.1016/j.jep.2006.07.032

[14] Edeoga, H. O., Okwu, D. E., & Mbaebie, B. O. (2005). Phytochemical constituents of some Nigerian medicinal plants. *African Journal of Biotechnology, 4*(7), 685–688.

[15] Grover, J. K., Yadav, S., & Vats, V. (2002). Medicinal plants of India with anti-diabetic potential. *Journal of Ethnopharmacology, 81*(1), 81–100.

https://doi.org/10.1016/S0378-8741(02)00059-4

[16] Gupta, R., & Bajpai, K. G. (2013). Antioxidant and antihyperglycemic potential of *Costus igneus* leaves in diabetic rats. *Pharmacognosy Research, 5*(2), 111–116. https://doi.org/10.4103/0974-8490.110524

[17] International Diabetes Federation. (2021). *IDF Diabetes Atlas* (10th Ed.). Brussels, Belgium: IDF.

[18] Jain, R., Sharma, A., Gupta, S., Sarethy, I. P., & Gabrani, R. (2011). Solanum nigrum: Current perspectives on therapeutic properties. *Alternative Medicine Review, 16*(1), 78–85.

[19] Jung, M., Park, M., Lee, H. C., Kang, Y. H., Kang, E. S., & Kim, S. K. (2006). Antidiabetic agents from medicinal plants. *Current Medicinal Chemistry, 13*(10), 1203–1218.

[20] Akila CR, Neelima S, Purushothaman M, Pradeep Kumar M. Evaluation of Nephroprotective activity Chrysanthemum parthenium against gentamycin-induced nephrotoxicity in WistarRats. International Journal of Pharmacy and Pharmaceutical Research, 9 (3): 36-44, 2017.

[21] BV Ramana, VV Kumar, PNR Krishna, CS Kumar, PUM Reddy, TN Raju," Effect Of Quercetin On Galactose-Induced Hyperglycaemic Oxidative Stress In Hepatic And Neuronal Tissues Of Wistar Rats" Acta Diabetologica. 2006;43:135-141.

[22] Kishore Babu.M, Ramana B.V and Murthy T.E.G.K, "Influence of polymers on release rate of carvedilol from transdermal films", Indian Drugs, 2008; 45 (12):970-974.

[23] BV Ramana, A Chaudhury, "Prevalence of uropathogens in diabetic patients and their resistance pattern at a tertiary care centre in south India, Int J Biol Med Res. 2012;3(1):1433-1435.

[24] Neelima S, Naresh Babu T, Pradeep Kumar M. Effect of shilajit on experimental models of inflammatory bowel disease in rats. International Journal of Current Pharmaceutical Research, 9 (4): 35-37, 2017. https://doi.org/10.2174/092986706776360860

[25] Kooti, W., Farokhipour, M., Asadzadeh, Z., Ashtary-Larky, D., & Asadi-Samani, M. (2016). The role of medicinal plants in the treatment of diabetes: A systematic review. *Electronic Physician, 8*(1), 1832–1842. https://doi.org/10.19082/1832

[26] Kumar, G. P., & Sudheesh, S. (2012). Anti-hyperglycemic and antioxidant effect of *Costus igneus* leaf extract in streptozotocin-induced diabetic rats. *Indian Journal of Experimental Biology, 50*(12), 882–890.